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U.S. Army Environmental Center

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FINAL

RCRA FACILITY INVESTIGATION
AND
RISK ASSESSMENT

MCALESTER ARMY AMMUNITION PLANT
McAlester, Oklahoma

Supplemental Phase II RFI Report Solid Waste Management Units 32 and 33

Submitted to:

Commander, Department of the Army
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1.0 INTRODUCTION

This report presents the results of the Supplemental Phase II Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) conducted for Solid Waste Management Units (SWMU) #32 and #33 at McAlester Army Ammunition Plant (MCAAP). The supplemental action of the RFI was conducted as part of the actions required in connection with the application for a RCRA permit for the management of hazardous waste at MCAAP. The objective of this Supplemental Phase II RFI is to collect and analyze soil samples from Solid Waste Management Unit (SWMU) 32 and SWMU 33 for dioxins/dibenzofurans.

The program reported here was conducted by Metcalf & Eddy (M&E) under Task Order 8 of Contract No. DAAA15-90-D-0016 for the U.S. Army Environmental Center (USAEC), formerly designated as the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA). The field work under this supplemental investigation was performed during August 1994.

The purpose of this report is to describe the procedures used to perform the Supplemental Phase II RFI, to present and assess the results obtained in terms of the nature and extent of any contamination found, to present the results of human health and ecological risk assessments, and to recommend future actions.

2.0 BACKGROUND

During the period of their operation, SWMU #32 and #33 consisted of wood pallet preserving areas consisting of open-sided steel structures set on concrete block foundations. This process consisted of immersing wooden pallets into vats containing a solution of pentachlorophenol (PCP) which was replaced with a copper-8-hydroxyquinolate solution in the late 1980s. The treated pallets were allowed to drip dry onto the concrete floor of the SWMU area. It is suspected that runoff from the floor may have flowed onto the soil adjacent to the building. Soil samples from both SWMUs were sampled and analyzed for PCP and copper during the Phase I RFI field investigation. The results of the investigation indicated that PCP was not present within soils surrounding these SWMUs.

Since chlorinated dioxins are known contaminants of PCP, additional testing of soils surrounding SWMU #32 and #33 was conducted for the Supplemental Phase II RFI.

3.0 FIELD INVESTIGATION

All soil sampling, decontamination, chain of custody, sample identification, and reporting procedures were followed as stated in the MCAAP RFI Supplemental Phase II Work Plan for SWMUs #32 and #33, dated August 5, 1994. The original MCAAP RFI Project Management Plan, Sampling and Analysis Plan, Health and Safety Plan, and Data Management Plan dated June 11, 1993 were followed during this supplemental investigation.

Soil samples were collected with a hand auger around the perimeter of Building 209 (SWMU #32) and Building 471 (SWMU #33) during this sampling event. The perimeter of each building was divided into four sections, A through D, from which eight shallow and eight deep soil samples were collected. Each section was divided into two tiers; the first tier consisted of samples collected within a distance of one foot and the second tier of samples were collected at a distance of approximately three feet from the building foundation, respectively.

Four composite soil samples were collected from each section. A shallow and deep soil sample were collected from each tier within the section. Generally, each composite sample consisted of four separate and equal volume samples collected within the give section. Shallow composite samples were collected from a depth of approximately 0 to 12 inches and deep composite samples were collected from a depth of 12 to 24 inches. At some locations composite samples were comprised of three or less individual soil samples or no samples were obtained due to compacted soil. A total of 16 soil samples were collected at SWMU #32 and 12 samples were collected at SWMU #33.

Composites were obtained by collecting soil samples, for a given depth, from four separate locations for each sample location. These collected soil samples were placed in a precleaned stainless steel bowl, mixed, then placed into appropriate sample containers.

For SWMU #32, samples 032SB09, 032SB13, 032SB17, and 032SB21 were collected and

analyzed for dioxins. Quality Control samples consisted of one equipment blank (032EB24) and one MS/MSD, samples 032MS17 and 032MD17. There was one field duplicate obtained, sample 032FD17. The remaining SWMU #32 samples were archived at the laboratory. Table 1 of Appendix A lists the samples obtained at SWMU #32, the approximate distance from the building that samples were obtained; depth of collection for each individual sample or auger refusal; date samples were collected; and whether or not the samples were analyzed or archived.

For SWMU #33, samples 033SB09, 033SB13, 033SB17, and 033SB21 were collected and analyzed for dioxins. No QA/QC samples were obtained. The remaining SWMU #33 samples were archived at the laboratory. Table 2 of Appendix A lists the samples obtained at SWMU #33, the approximate distance from the building that samples were obtained; depth of collection for each individual sample or auger refusal; date samples were collected; and whether or not the samples were analyzed or archived.

Analysis of soil samples were to be performed in a phase approach. It is assumed that runoff from the pallet dipping operation, if it occurred, impacted adjacent soil by infiltrating from the land surface downward into the soil. Surface soils would be the most impacted by this mechanism. Both shallow and deep soil samples were be collected at the same time from around the perimeter of each SWMU. Shallow soil samples (i.e., 0 to 12 inch depth) were analyzed first. Analysis of shallow samples did not exhibit concentrations of dioxins/dibenzofurans at a concentration of concern. As a result, the associated underlying soil samples (i.e., 12 to 24 inch depth) were not analyzed to determine, in part, if the dioxins/dibenzofurans are migrating downward through the soil or if the contaminants are limited to surface soils. Research on dioxin mobility in soils observed that the mobility of dioxins (2,7-DCDD and 2,3,7,8-TCDD) decreased with increasing organic content of the soil. Based on this observation and the finding that these dioxins were relatively immobile in the soils tested, the conclusion was that these dioxins would pose no threat to groundwater supplies because they would not be mobilized deep into soils by rainfall (U.S. EPA, 1980).

4.0 RESULTS OF FIELD INVESTIGATION

4.1 SWMU #32 Results

4.1.1 Topography

The small study area of SWMU #32 (approximately 500 feet by 200 feet) is relatively flat at an elevation of 775 feet above msl. Small intermittent drainage ditches lie to the north along the railroad tracks and to the south along Road 5.

4.1.2 Characteristics of the Soil/Sediment

According to the soil survey map for Pittsburg County, soils contained within the study area are comprised of the Eram Series of the Talihina-Eram-Collinsville association as described in the Final RFI report.

The soil sampled around the perimeter of the SWMU is likely not that of the Eram Soil Series. Field identification of collected soils have a significantly different composition. The 0 to 12 inch depth interval generally is described as a light brown, coarse silty sand with large angular gravel. The 12 to 24 inch depth interval contained coarse sand, pea gravel, gravel, and stiff clay. Soil type could not be determined along the north side of the pallet dip building due to the presence of railroad gravel. It can be concluded that the type of soil material encountered around the perimeter of SWMU #32 is different than the reported native soils of the area. This supports earlier reports stating contaminated soils from around the building were periodically removed. The excavated areas were apparently backfilled with clean fill.

4.1.3 Nature and Extent of Contamination

Results of Supplemental Phase II RFI chemical analyses of soil samples from SWMU #32 are displayed on Figure 1.

4.1.4 Dioxin/Dibenzofurans Constituents Found in Soils

Soil samples 032SB09, 032SB13, 032SB17, and 032SB21, collected around the perimeter of SWMU #32, were analyzed for dioxin and dibenzofurans. Low concentrations of dioxin/dibenzofurans were detected in all four analyzed samples. The highest concentration of dioxin/dibenzofurans were detected along the western side of Building 209 within soil obtained from the 0 to 12 inch depth interval (i.e., samples 032SB09 and 032SB17).

4.2 SWMU #33 Results

4.2.1 Topography

The small study area of SWMU #33 (approximately 500 feet by 200 feet) is relatively flat with drainage to the east along the entrance to the facility. The area is at an elevation of approximately 800 feet above msl.

4.2.2 Characteristics of the Soil/Sediment

According to the soil survey map for Pittsburg County, soils contained with the study areas are comprised of the Enders Series of the Enders-Hector-Hartsells Association as described in the Final RFI Report. The soil sampled around the perimeter of SWMU #33 is likely not that of the Enders Soil series. Field identification of collected soils have a significantly different composition. The 0 to 12 inch depth interval is described as a light brown, coarse silty sand with large angular gravel. The 12 to 24 inch depth interval contained coarse sand, pea gravel, gravel and stiff clay. It can be concluded that the type of soil material encountered around the perimeter of SWMU #33 is different than the reported native soils of the area.

4.2.3 Nature and Extent of Contamination

Results of Supplemental Phase II RFI chemical analyses of soil samples from SWMU #33 are displayed on Figure 2.

4.2.4 Dioxin/Dibenzofurans Constituents Found in Soils

Soil samples 033SB09, 033SB13, 033SB17, and 033SB21, collected around the perimeter of SWMU #32, were analyzed for dioxin and dibenzofurans. Low concentrations of dioxin/dibenzofurans were detected within all four samples. The highest concentration of dioxin/dibenzofurans was detected along the north side of Building 471 (i.e., sample 033SB13) and around the unloading dock Building 208 (i.e., sample 033SB21) within soil collected from the 0 to 12 inch depth interval.

4.3 Summary of Findings

Soil samples collected at a depth of 0 to 12 inches from around the perimeter of SWMUs #32 and #33 were analyzed for dioxin and dibenzofurans. Low concentrations of these compounds were detected in all analyzed soil samples. The highest concentration of dioxin and dibenzofurans were detected at SWMU #33.

5.0 Summary of Human Health Risk Assessment

SWMUs # 32 and #33 are located in unused portions of the installation and are currently inactive. During the period of operation at Buildings 209 and 471, wooden pallets were immersed into dipping vats containing pentachlorophenol (PCP) solution. The treated pallets dripped onto the concrete floor. Soil was sampled at the SWMUs for chlorinated dioxins and furans. Other media were not sampled because of the low probability of occurrence, low mobility of chemicals in the media, and because the results of previous investigations have not warranted additional sampling. Summaries of the dioxin and furan concentrations detected in the soil samples are presented in Tables 1 and 2.

A human health risk assessment (RA) was performed for SWMUs #32 and #33. A hypothetical future exposure scenario was considered for potential future site use. MCAAP is an active facility and is utilized for either occupational or recreational purposes. There are no residences located near any of the SWMUs investigated in the RFI. The area surrounding Building 209 is covered by vegetation (i.e., trees, shrubs, vegetation). Facility workers do not

enter into the SWMU area on a regular basis as it is located away from the active areas of the MCAAP. The most likely receptors would be trespassers, hunters, or hikers who would enter into the area on a sporadic/intermittent basis.

The RA was prepared, in accordance with U.S EPA RA guidance, to characterize both existing and future scenarios (U.S. EPA, 1989a). Risk assessments must include an evaluation of the RME which provides a conservative (above the average case) estimate of exposure. The most likely, feasible existing and future hypothetical use for SWMUs #32 and #33 would be for recreational (i.e., hunting, hiking, etc.) or occupational purposes. It is expected that occupational use exposures would encompass any recreational pathways. Therefore, the receptor group associated with the RME would likely be the occupational receptor for exposure to soil. The occupational use of the sites was considered whereby the primary exposure pathway would involve soil (ingestion, dermal contact, and inhalation) pathway exposures. Parameter values utilized in the exposure assessment are provided in Tables 3, 4, and 5.

A toxicity assessment for dioxins and furans was performed using toxicity equivalent factors (TEFs) recommended in the U.S. EPA's "Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and - Dibenzofurans (CDDs and CDFs) and 1989 Update (U.S. EPA, 1989b). The toxicity equivalents for the various congeners are presented in Tables 1 and 2. Noncancer toxicity values have not been developed for dioxins and furans. The TEF approach is based on the structure-activity relationship of all of the 209 CDD\CDF congeners compared to 2,3,7,8-TCDD. U.S. EPA has developed a cancer slope factor of 1.5E+05 (mg/kg/day)-1 for both oral and inhalation exposure pathways (U.S. EPA, 1994). Therefore, the toxicity equivalents for the CDDs and CDFs detected in SWMUs #32 and #33 were utilized to adjust the chemical concentrations found in the soil samples.

A soil risk characterization was performed to predict total cancer risk levels based on the results of the exposure assessment and toxicity assessment. The potential for carcinogenic effects is evaluated in the risk characterization by determining the probability that an individual will develop cancer over a lifetime of exposure to the chemicals of concern. This estimated probability for cancer development is described as the carcinogenic risk. For exposure to

chemical carcinogens at sites where hazardous substances have been released, U.S. EPA's National Contingency Plan (NCP) requires that the lifetime cancer risk at a particular site should fall within the range of 1 in 10,000 (1.0E-04) and 1 in 1,000,000 (1.0E-06) depending on a number of factors including cost, technical feasibility and public acceptance (U.S. EPA, 1991b). Similarly, U.S. EPA's proposed guidance for corrective actions for SWMUs at Hazardous Waste Management Facilities recommends similar guidelines (U.S. EPA 1990). This policy states that acceptable exposure levels are generally concentration levels that represent a cumulative excess upper bound lifetime cancer risk to an individual between 1.0E-4 and 1.0E-6.

The results of the risk characterization are presented in Tables 6, 7, and 8. Maximum detected CDD and CDF concentrations were utilized in the risk calculations. Noncancer hazards were not calculated because noncancer toxicity values have not been developed for the dioxins and furans. The findings of the risk characterization for SWMUs #32 and #33 (Table 6) showed that the total carcinogenic risk was below a 1E-04 risk for samples obtained from SWMU #32, but the risk was slightly above a 1E-04 risk (total risk = 1.8 E-04) for the total long-term risk associated with the maximum concentrations detected in SWMU #33. Additional evaluation of the risk associated with each sample obtained from SWMU #33 (Table 7) showed that the carcinogenic risk was attributable to concentrations detected in two of the four samples (033SB13/10205 and 033SB21/10213) obtained from SWMU #33. It is notable that these are the only two samples where the 2,3,7,8-TCDD congener was detected in SWMUs #32 and #33. As indicated in Table 8, potential dermal exposure serves as the pathway which provides the primary contribution to total risks which are greater than a 1E-04 risk.

Overall, the risk assessment results show that risks are within acceptable risk criteria for SWMU #32. The risks for SWMU #33 do exceed the risk criteria for hypothetical long-term future occupational exposure. There may be some uncertainty in the estimation of exposure to chemicals through dermal uptake. 2,3,7,8 TCDD is one of the few compounds for which there is dermal absorption research information available (U.S. EPA, 1992). However, the association between dermal absorption and dioxin toxicity may not be as strongly linked compared to more direct (ingestion, inhalation) pathways. This is particularly true for situations where the CDD/CDF congeners are tightly absorbed to the organic matter in soils.

It should also be noted that there are some uncertainties in the TEF approach for evaluating potential CDD and CDF toxicity. The majority of the available toxicity information for CDDs and CDFs are focused on 2,3,7,8 TCDD, with relatively little information from long term in vivo studies on the other congeners. The existing research for congeners other than 2,3,7,8 TCDD is primarily based on short-term in vivo and in vitro studies covering a wide range of toxicological endpoints. While there is a difference in doses among the congeners necessary to elicit a given toxic response, the relative potency of the compounds, compared to 2,3,7,8-TCDD is fairly consistent from one endpoint to another. However there are elements of uncertainty in the TEF approach, such as differentiating among species the ability metabolize the CDD/CDF congeners, and the bias introduced by extrapolating from short-term to long-term effects. Currently, there are no studies which definitively demonstrate an association between exposure to CDD/CDFs and an increased risk of cancer in human populations.

In a recently published article (Boroush and Gough, 1994), the authors speculate that one of the reasons why epidemiologic studies have failed to establish an association between exposure to CDD/CDFs and cancer may be the low levels of exposure that humans have experienced compared to laboratory animals. Even if it is assumed that U.S. EPA's cancer slope factor estimate for dioxin is applicable to humans as well as to rodents, it is highly unlikely that the predictions made by risk assessment methods could ever be detected in the human population. The authors postulate that the most promising epidemiological approach for detecting an association would be to focus on a specific cancer, e.g. soft tissue sarcomas, in a relatively highly exposed population. It is likely that these conclusions are applicable in the case of SWMU #33 where estimated risks are associated with hypothetical future, rather than any existing or actual exposures for the area. Therefore, it is expected that the estimated risks are conservative and may over-estimate the true risk for any future site receptors.

6.0 Summary of Ecological Assessment

Considering the current use and conditions at SWMU #33, only minimal exposure of ecological receptors to dioxin in soil is anticipated. The area immediately surrounding the pallet-dipping building, where the dioxins have been detected, is predominantly gravel and compacted soil that has been used as a vehicle parking and turn-around area. The area is devoid of

vegetation, and the soils are compacted to the extent that burrowing animals would have difficulty in burrowing. Due to these factors, terrestrial receptors would only be expected in the area for short periods, usually passing through the area quickly to reach the more desirable habitats which surround the SWMUs. During any transitory movement over SWMU #33 soils, terrestrial receptors would only be expected to experience exposure to surficial soil, where concentrations are anticipated to be lower, due to photodegration of the dioxin congeners. Since burrowing is effectively precluded at this site, exposure to the higher levels reported in the upper one foot of soil is unlikely.

7.0 Conclusions

Results of sampling and analysis of soil from SWMUs #32 and #33 indicated the presence of chlorinated dioxin and furan congeners. The Pallet Dipping Operations, which previously occurred at these SWMUs were the likely source of the compounds within soils surrounding Buildings 209 and 471.

The results of the human health RA for SWMUs #32 and #33 showed that the most likely exposure scenarios for soil would be occupational. The results showed that estimated total carcinogenic risk were acceptable according to U.S. EPA criteria for the occupational receptor group for SWMU #32. Risks for SWMU #33 were above U.S. EPA criteria for the two samples where 2,3,7, 8 TCDD was detected. The risks for the SWMU #33 samples may be overestimated based on the conservative nature of the estimation of dermal exposure to soil and the use of the toxicity equivalence methodology for estimating risk.

No further action is warranted for both SWMUs #32 and #33 due to the absence of significant human health risk and ecological risk at these SWMUs.

TABLE 1 SUMMARY OF SOIL ANALYTICAL RESULTS FOR SWMU 32

CHEMICAL	SAMPLE LOCATION/ID 032SB09 10185	032SB13 10189	032SB21 10197	032SB17 10193	032SB17 40219	FREQUENCY OF DETECTION	AVERAGE	MINIMUM CONCENTRATION DETECTED (PPT)	MAXIMUM CONCENTRATION DETECTED (PPT)	EXPOSURE CONCENTRATION (PPT)
2,3,7,8-TCDD	<12.0	<0.9	<6.2	<4.0	<4.8	0/5	3.0	NA	NA	NA
1,2,3,7,8-PeCDD	23.2	14.6	30.8	<45.9	<46.2	3/5	22.9	14.60	30.8	31
1,2,3,4,7,8-HxCDD	89.2	44.2	80.3	119	145	5/5	89.7	44.2	145	145
1,2,3,6,7,8-HxCDD	388	173	306	502	574	5/5	360	173	574	574
1,2,3,7,8,9-HxCDD	192	102	197	275	322	5/5	203	102	322	322
1,2,3,4,6,7,8-HpCDD	13110	4280	8350	21160	23820	5/5	12390	4280	23820	23820
1,2,3,4,6,7,8,9-OCDD	103250	36850	64090	174530	183250	5/5	96860	36850	183250	183250
2,3,7,8-TCDF	<8.6	3.6	<4.7	<6.9	7.0	2/5	4.3	3.6	7.0	7.0
1,2,3,7,8-PeCDF	<19.5	11.4	23.6	27.1	27.1	4/5	18.0	11.4	27.1	27
2,3,4,7,8-PeCDF	12.2	9.2	14.1	<19.3	22.0	4/5	14.4	9.2	22	22
1,2,3,4,7,8-HxCDF	131	53.2	104	142	156	5/5	111	53.2	156	156
1,2,3,6,7,8-HxCDF	96.9	54.1	84.9	113	119	5/5	88.7	54.1	119	119
2,3,4,6,7,8-HxCDF	133	60.3	106	156	165	5/5	116	60.3	165	165
1,2,3,7,8,9-HxCDF	<11.7	<1.2	<6.5	<4.2	<5.2	0/5	3.1	NA	NA	NA
1,2,3,4,6,7,8-HpCDF	1600	650	1080	1690	2010	5/5	1335	650	2010	2010
1,2,3,4,7,8,9-HpCDF	172	42.1	87.3	139	163	5/5	116	42.1	172	172
1,2,3,4,6,7,8,9-OCDF	4980	1150	1780.0	3860	4810	5/5	3055	1150	4980	4980

PPT – parts per trillion

"ND" AND "<" indicate that the analyte was not detected

NA – Not applicable

TABLE 1 SUMMARY OF SOIL ANALYTICAL RESULTS FOR SWMU 32

CHEMICAL	EXPOSURE CONCENTRATION (PPT)	EXPOSURE CONCENTRATION (MG/KG)	CONCENTRATION SUMS OF CONGENER GROUPS (MG/KG)	TOXICITY EQUIVALENCE FACTOR (TEF)	TEF APPLIED TO THE SUM OF EACH CONGENER GROUP (MG/KG)
2,3,7,8-TCDD	NA	NA	NA	1	NA
1,2,3,7,8-PeCDD	31	3.08E-05	3.08E-05	0.5	1.54E-05
1,2,3,4,7,8-HxCDD	145	1.45E-04	1.04E-03	0.1	1.04E-04
1,2,3,6,7,8-HxCDD	574	5.74E-04			
1,2,3,7,8,9-HxCDD	322	3.22E-04			
1,2,3,4,6,7,8-HpCDD	23820	2.38E-02	2.38E-02	0.01	2.38E-04
1,2,3,4,6,7,8,9-OCDD	183250	1.83E-01	1.83E-01	0.001	1.83E-04
2,3,7,8-TCDF	7.0	7.00E-06	7.00E-06	0.1	2.71E-08
1,2,3,7,8-PeCDF	27	2.71E-05	2.71E-05	0.05	2.71E-08
2,3,4,7,8-PeCDF	22	2.20E-05	2.20E-05	0.5	2.20E-08
1,2,3,4,7,8-HxCDF	156	1.56E-04	4.40E-04	0.1	4.40E-05
1,2,3,6,7,8-HxCDF	119	1.19E-04			
2,3,4,6,7,8-HxCDF	165	1.65E-04			
1,2,3,7,8,9-HxCDF	NA	NA			
1,2,3,4,6,7,8-HpCDF	2010	2.01E-03	2.18E-03	0.01	2.18E-05
1,2,3,4,7,8,9-HpCDF	172	1.72E-04			
1,2,3,4,6,7,8,9-OCDF	4980	4.98E-03	4.98E-03	0.001	4.98E-06
			TOTAL CONGENER GROUP SUMMED:		6.24E-04

PPT – parts per trillion
NA – Not applicable

TABLE 2 SUMMARY OF SOIL ANALYTICAL RESULTS FOR SWMU 33

CHEMICAL	SAMPLE LOCATION/ID 033SB09 10201	033SB17 10209	033SB21 10213	033SB13 10205	FREQUENCY OF DETECTION	AVERAGE	MINIMUM CONCENTRATION DETECTED (PPT)	MAXIMUM CONCENTRATION DETECTED (PPT)	EXPOSURE CONCENTRATION (PPT)
2,3,7,8-TCDD	<5.5	<6.4	7.7	15.9	2/4	7.4	7.70	15.9	16
1,2,3,7,8-PeCDD	42.2	<45.8	282	<233	2/4	115.9	42.2	282	282
1,2,3,4,7,8-HxCDD	126	122	703	734	4/4	421.3	122	734	734
1,2,3,6,7,8-HxCDD	506	500	2120	2710	4/4	1459.0	500	2710	2710
1,2,3,7,8,9-HxCDD	302	337	1650	1570	4/4	964.8	302	1650	1650
1,2,3,4,6,7,8-HpCDD	15070	16930	58370	93350	4/4	45930.0	15070	93350	93350
1,2,3,4,6,7,8,9-OCDD	117720	159890	188620	400890	4/4	216780.0	117720	400890	400890
2,3,7,8-TCDF	<7.8	<6.5	97.9	<29.8	1/4	31.0	3.6	97.9	98
1,2,3,7,8-PeCDF	<9.6	23.3	214	144	3/4	96.5	11.4	214	214
2,3,4,7,8-PeCDF	22.5	22.3	163	113	4/4	80.2	22.3	163	163
1,2,3,4,7,8-HxCDF	198	175	936	954	4/4	565.8	175	954	954
1,2,3,6,7,8-HxCDF	156	136	775	694	4/4	440.3	136	775	775
2,3,4,6,7,8-HxCDF	197	181	1060	1100	4/4	634.5	181	1100	1100
1,2,3,7,8,9-HxCDF	<5.5	<5.8	<18.1	<91.8	0/4	15.2	NA	NA	NA
1,2,3,4,6,7,8-HpCDF	2480	2390	9090	13150	4/4	6777.5	2390	13150	13150
1,2,3,4,7,8,9-HpCDF	187	185	801	1540	4/4	678.3	185	1540	1540
1,2,3,4,6,7,8,9-OCDF	4830	4740	8030	20170	4/4	9442.5	4740	20170	20170

"ND" AND "<" indicate that the analyte was not detected

PPT – parts per trillion

NA – Not applicable

TABLE 2 SUMMARY OF SOIL ANALYTICAL RESULTS FOR SWMU 33

CHEMICAL	EXPOSURE CONCENTRATIO (PPT)	EXPOSURE CONCENTRATION (MG/KG)	CONCENTRATION SUMS OF CONGENER GROUPS (MG/KG)	TOXICITY EQUIVALENCE FACTOR (TEF)	TEF APPLIED O THE SUM OF EAC CONGENER GROUP (MG/KG)
2,3,7,8-TCDD	16	1.59E-05	1.59E-05	1	1.59E-05
1,2,3,7,8-PeCDD	282	2.82E-04	2.82E-04	0.5	1.41E-04
1,2,3,4,7,8-HxCDD	734	7.34E-04	5.09E-03	0.1	5.09E-04
1,2,3,6,7,8-HxCDD	2710	2.71E-03			
1,2,3,7,8,9-HxCDD	1650	1.65E-03			
1,2,3,4,6,7,8-HpCDD	93350	9.34E-02	9.34E-02	0.01	9.34E-04
1,2,3,4,6,7,8,9-OCDD	400890	4.01E-01	4.01E-01	0.001	4.01E-04
2,3,7,8-TCDF	98	9.79E-05	9.79E-05	0.1	9.79E-06
1,2,3,7,8-PeCDF	214	2.14E-04	2.14E-04	0.05	1.07E-05
2,3,4,7,8-PeCDF	163	1.63E-04	1.63E-04	0.5	8.15E-05
1,2,3,4,7,8-HxCDF	954	9.54E-04	2.83E-03	0.1	2.83E-04
1,2,3,6,7,8-HxCDF	775	7.75E-04			
2,3,4,6,7,8-HxCDF	1100	1.10E-03			
1,2,3,7,8,9-HxCDF	NA	NA			
1,2,3,4,6,7,8-HpCDF	13150	1.32E-02	1.47E-02	0.01	1.47E-04
1,2,3,4,7,8,9-HpCDF	1540	1.54E-03			
1,2,3,4,6,7,8,9-OCDF	20170	2.02E-02	2.02E-02	0.001	2.02E-05
			TOTAL CONGENER GROUP SUMMED:		2.55E-03

TABLE 3

INCIDENTAL INGESTION OF SOIL

[Equation and Parameter Values Derived from U.S. EPA, 1989a,c
Unless Otherwise Noted]

$$\text{Intake (mg/kg day)} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

VARIABLE	VARIABLE DESCRIPTION	VARIABLE ASSUMPTIONS
CS	Constituent Concentration in Soil (mg/kg)	Chemical Specific (mg/kg)
IR	Ingestion Rate (mg soil/day)	50 mg/day (adult-worker)
CF	Conversion Factor (10^{-6} kg/mg)	10^{-6} kg/mg
FI	Fraction Ingested from Contaminated Source (unitless)	1.0
EF	Exposure Frequency (days/year)	250 days/year (adult worker)
ED	Exposure Duration (years)	25 years (adult worker long-term) 5 years (adult worker short-term)
BW	Body Weight (kg)	70 kg (adult)
AT	Averaging Time (period over which exposure is averaged - days)	25,550 days (carcinogenic effects) ED x 365 days/year (chronic noncarcinogenic and subchronic effects)

TABLE 4

DERMAL CONTACT WITH SOIL

[Equation and Parameter Values Derived from U.S. EPA, 1989a,c Unless Otherwise Noted]

$$\text{Absorbed Dose (mg/kg - day)} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

VARIABLE	VARIABLE DESCRIPTION	VARIABLE ASSUMPTIONS
CS	Constituent concentration in soil (mg/kg)	Chemical Specific (mg/kg)
CF	Conversion Factor (10^{-6} kg/mg)	10^{-6} kg/mg
SA	Skin Surface Area Available for Contact (cm^2/event) head, hands	6130 cm^2/event (adult)
AF	Soil to Skin Adherence Factor	1.0 mg/cm^2
ABS	Absorption Factor (unitless)	Chemical Specific
EF	Exposure Frequency (days/year)	250 days/year (adult worker)
ED	Exposure Duration (years)	25 years (adult-worker, long-term) 5 years (adult worker, short-term)
BW	Body Weight (kg)	70 kg (adult)
AT	Averaging Time (period over which exposure is averaged - days)	25,550 days (carcinogenic effects) ED x 365 days/year (chronic noncarcinogenic and subchronic effects)

TABLE 5

INHALATION OF VAPORS AND DUSTS FROM SOIL

[Equation and Parameter Values Derived from U.S. EPA, 1989a,c Unless Otherwise Noted]

$$\text{Intake (mg/kg day)} = \frac{CA \times IR \times ET \times EF \times ED \times CF}{BW \times AT}$$

VARIABLE	VARIABLE DESCRIPTION	VARIABLE ASSUMPTIONS
CA	Chemical Concentration in Air (mg/m^3)	Chemical Specific (mg/m^3)
IR	Inhalation Rate (m^3/hr)	0.83 m^3/hour (adult worker)
ET	Exposure Time (hours/day)	8 hours/day (adult worker)
EF	Exposure Frequency (days/year)	250 days/year (adult worker, long-term)
ED	Exposure Duration (years)	25 years (adult-worker, long-term) 5 years (adult-worker, short-term)
BW	Body Weight (kg)	70 kg (adult)
AT	Averaging Time (period over which exposure is averaged - days)	25,550 days (carcinogenic effects)

TABLE 6 SUMMARY OF THE RISKS FROM MAXIMUM CONCENTRATIONS FOR SWMU 32 AND 33

	SWMU 32		SWMU 33	
TOTAL SWMU-SPECIFIC RISK (Using maximum concentrations from all samples)	SHORT TERM	LONG TERM	SHORT TERM	LONG TERM
	8.63E-06	4.31E-05	3.53E-05	1.76E-04

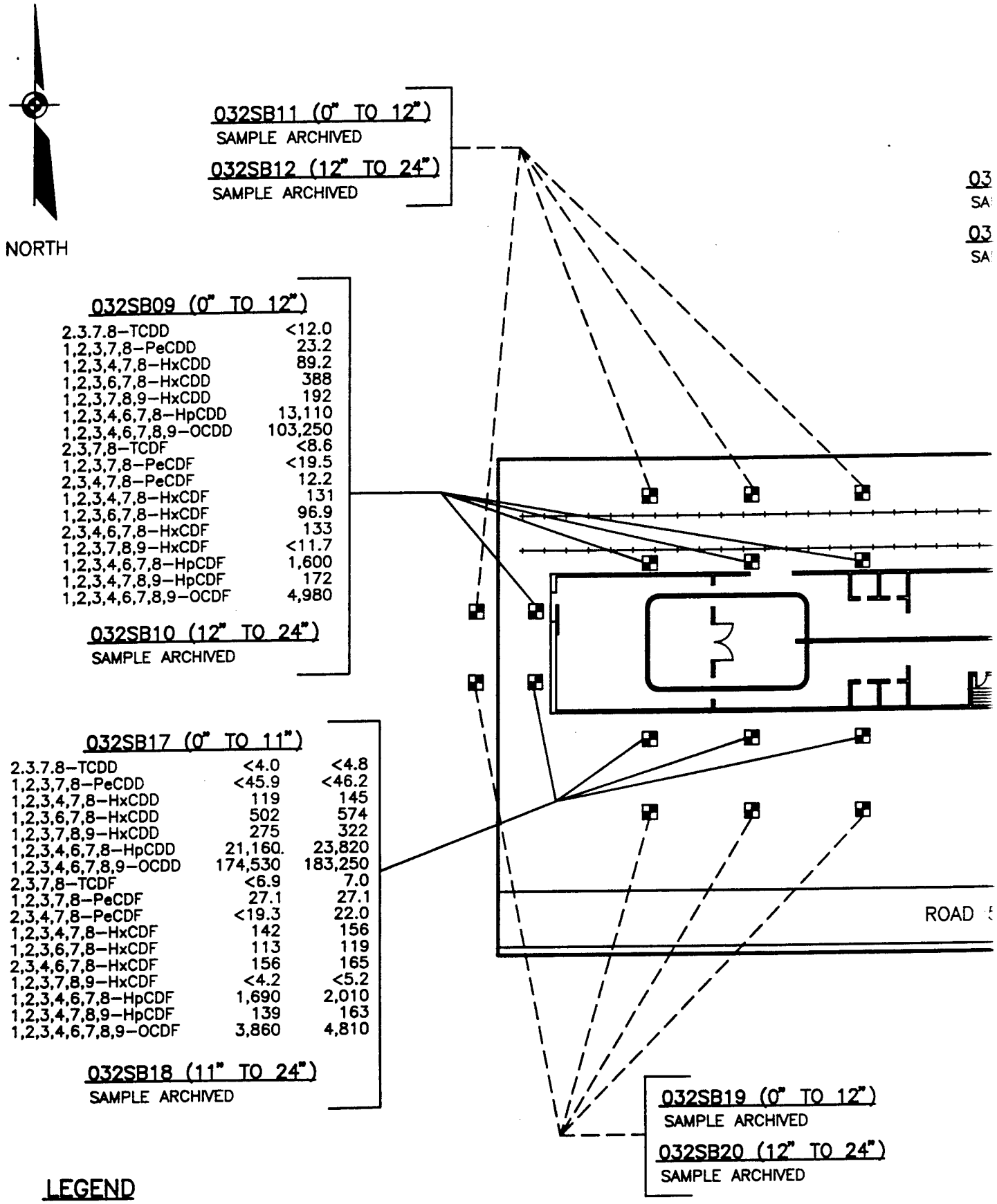
TABLE 7 SUMMARY OF THE RISKS FROM SOIL SAMPLES FOR SWMU 32 AND 33 AT MCAAP

TOTAL SAMPLE-SPECIFIC RISK	OCCUPATIONAL WORKER RECEPTOR					
	SWMU 32			SWMU 33		
	SAMPLE/ID	SHORT TERM RISK	LONG TERM RISK	SAMPLE/ID	SHORT TERM RISK	LONG TERM RISK
	032SB09/10185	5.22E-06	2.61E-05	033SB09/10201	6.65E-06	3.32E-05
	032SB13/10189	2.06E-06	1.03E-05	033SB13/10205	3.26E-05	1.63E-04
	032SB17/10197	8.41E-06	4.20E-05	033SB17/10209	7.15E-06	3.58E-05
	032SB21/10193-40219	3.76E-06	1.89E-05	033SB21/10213	2.55E-05	1.28E-04

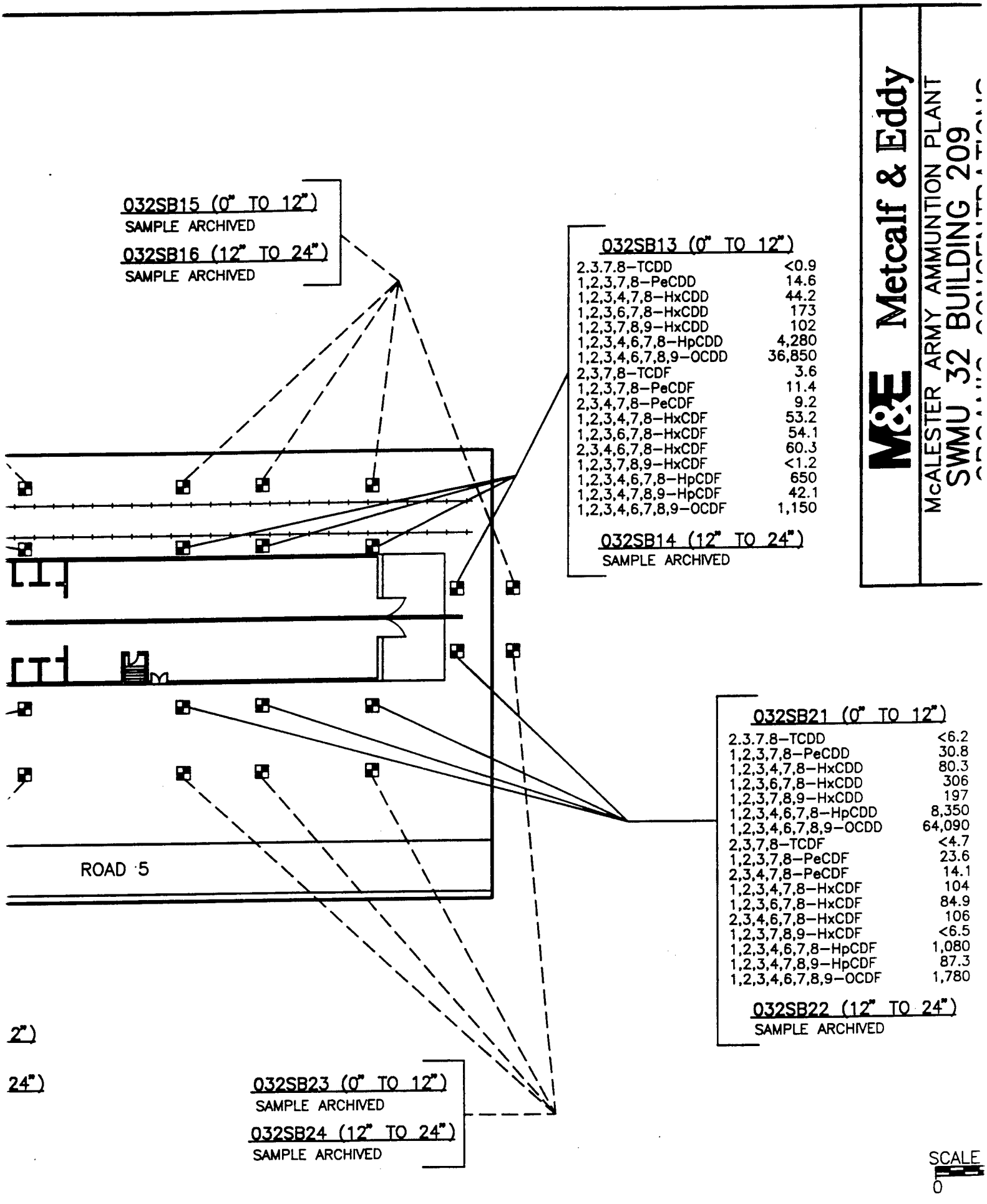
TABLE 8 SAMPLE-SPECIFIC SUMMARY OF THE DIOXIN-ASSOCIATED RISKS FROM SOIL FOR SWMUs 32 AND 33 AT MCAAP

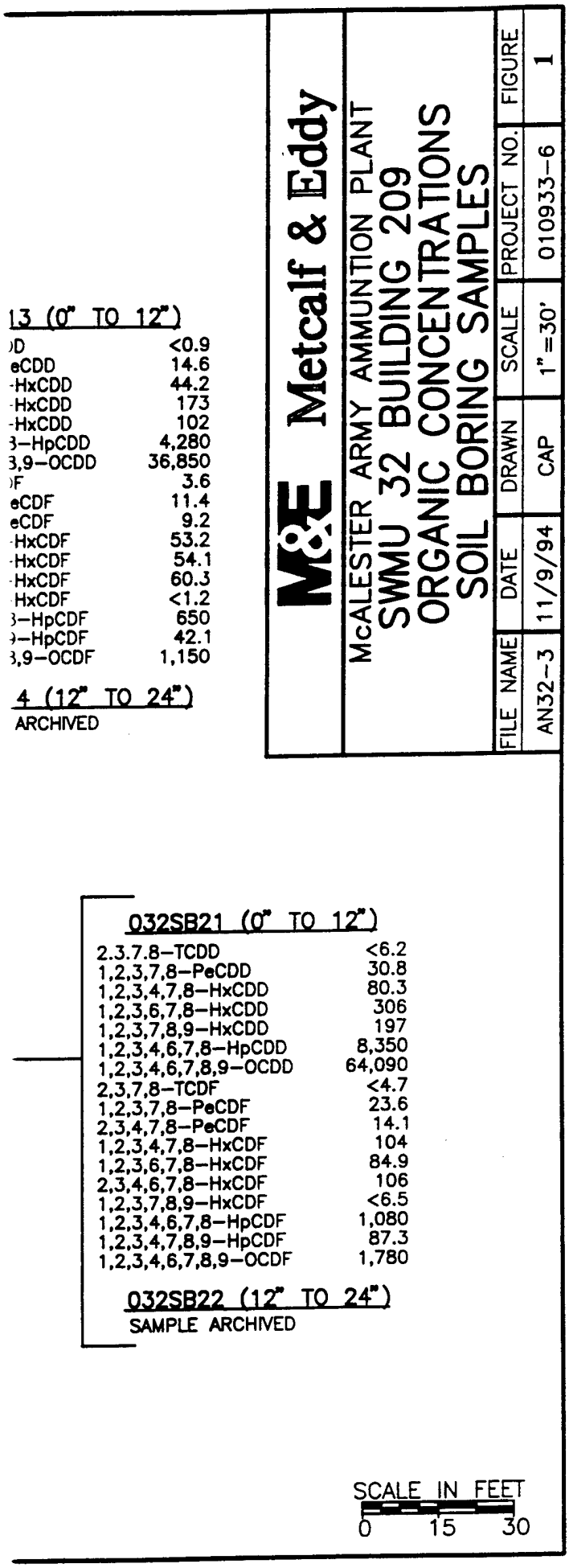
SWMU 32	OCCUPATIONAL WORKER RECEPTOR							
	ADULT (SHORT TERM)				ADULT (LONG TERM)			
SAMPLE/ID	INGESTION	DERMAL	INHALATION	TOTAL	INGESTION	DERMAL	INHALATION	TOTAL
032SB09/10185	1.98E-06	3.24E-06	4.23E-09	5.22E-06	9.90E-06	1.62E-05	2.12E-08	2.61E-05
032SB13/10189	7.81E-07	1.28E-06	1.67E-09	2.06E-06	3.90E-06	6.38E-06	8.34E-09	1.03E-05
032SB17/10197	3.19E-06	5.21E-06	6.81E-09	8.41E-06	1.59E-05	2.61E-05	3.41E-08	4.20E-05
032SB21/10193-40219	1.43E-06	2.33E-06	3.05E-09	3.76E-06	7.14E-06	1.17E-05	1.53E-08	1.89E-05

SWMU 33	OCCUPATIONAL WORKER RECEPTOR							
	ADULT (SHORT TERM)				ADULT (LONG TERM)			
SAMPLE/ID	INGESTION	DERMAL	INHALATION	TOTAL	INGESTION	DERMAL	INHALATION	TOTAL
033SB09/10201	2.52E-06	4.12E-06	5.38E-09	6.65E-06	1.26E-05	2.06E-05	2.69E-08	3.32E-05
033SB13/10205	1.24E-05	2.02E-05	2.64E-08	3.26E-05	6.18E-05	1.01E-04	1.32E-07	1.63E-04
033SB17/10209	2.71E-06	4.43E-06	5.79E-09	7.15E-06	1.36E-05	2.22E-05	2.90E-08	3.58E-05
033SB21/10213	9.67E-06	1.58E-05	2.07E-08	2.55E-05	4.84E-05	7.91E-05	1.03E-07	1.28E-04


NORTH
032SB11 (0" TO 12")
SAMPLE ARCHIVED
032SB12 (12" TO 24")
SAMPLE ARCHIVED
032SB09 (0" TO 12")
2.3.7.8-TCDD <12.0
1,2,3,7,8-PeCDD 23.2
1,2,3,4,7,8-HxCDD 89.2
1,2,3,6,7,8-HxCDD 388
1,2,3,7,8,9-HxCDD 192
1,2,3,4,6,7,8-HpCDD 13,110
1,2,3,4,6,7,8,9-OCDD 103,250
2,3,7,8-TCDF <8.6
1,2,3,7,8-PeCDF <19.5
2,3,4,7,8-PeCDF 12.2
1,2,3,4,7,8-HxCDF 131
1,2,3,6,7,8-HxCDF 96.9
2,3,4,6,7,8-HxCDF 133
1,2,3,7,8,9-HxCDF <11.7
1,2,3,4,6,7,8-HpCDF 1,600
1,2,3,4,7,8,9-HpCDF 172
1,2,3,4,6,7,8,9-OCDF 4,980
032SB10 (12" TO 24")
SAMPLE ARCHIVED
032SB17 (0" TO 11")
2.3.7.8-TCDD <4.0 <4.8
1,2,3,7,8-PeCDD <45.9 <46.2
1,2,3,4,7,8-HxCDD 119 145
1,2,3,6,7,8-HxCDD 502 574
1,2,3,7,8,9-HxCDD 275 322
1,2,3,4,6,7,8-HpCDD 21,160. 23,820
1,2,3,4,6,7,8,9-OCDD 174,530 183,250
2,3,7,8-TCDF <6.9 7.0
1,2,3,7,8-PeCDF 27.1 27.1
2,3,4,7,8-PeCDF <19.3 22.0
1,2,3,4,7,8-HxCDF 142 156
1,2,3,6,7,8-HxCDF 113 119
2,3,4,6,7,8-HxCDF 156 165
1,2,3,7,8,9-HxCDF <4.2 <5.2
1,2,3,4,6,7,8-HpCDF 1,690 2,010
1,2,3,4,7,8,9-HpCDF 139 163
1,2,3,4,6,7,8,9-OCDF 3,860 4,810
032SB18 (11" TO 24")
SAMPLE ARCHIVED
032SB19 (0" TO 12")
SAMPLE ARCHIVED
032SB20 (12" TO 24")
SAMPLE ARCHIVED
ROAD
LEGEND
SOIL BORING
< ANALYTE NOT DETECTED
NOTE: ALL CONCENTRATIONS IN PPT (PARTS PER TRILLION)

(1)


032SB15 (0" TO 12")
SAMPLE ARCHIVED
032SB16 (12" TO 24")
SAMPLE ARCHIVED
032SB13 (0" TO 12")
2.3.7.8-TCDD <0.9
1,2,3,7,8-PeCDD 14.6
1,2,3,4,7,8-HxCDD 44.2
1,2,3,6,7,8-HxCDD 173
1,2,3,7,8,9-HxCDD 102
1,2,3,4,6,7,8-HpCDD 4,280
1,2,3,4,6,7,8,9-OCDD 36,850
2,3,7,8-TCDF 3.6
1,2,3,7,8-PeCDF 11.4
2,3,4,7,8-PeCDF 9.2
1,2,3,4,7,8-HxCDF 53.2
1,2,3,6,7,8-HxCDF 54.1
2,3,4,6,7,8-HxCDF 60.3
1,2,3,7,8,9-HxCDF <1.2
1,2,3,4,6,7,8-HpCDF 650
1,2,3,4,7,8,9-HpCDF 42.1
1,2,3,4,6,7,8,9-OCDF 1,150
032SB14 (12" TO 24")
SAMPLE ARCHIVED
M&E Metcalf & Eddy
McALESTER ARMY AMMUNTION PLANT
SWMU 32 BUILDING 209
ROAD 5
032SB21 (0" TO 12")
2.3.7.8-TCDD <6.2
1,2,3,7,8-PeCDD 30.8
1,2,3,4,7,8-HxCDD 80.3
1,2,3,6,7,8-HxCDD 306
1,2,3,7,8,9-HxCDD 197
1,2,3,4,6,7,8-HpCDD 8,350
1,2,3,4,6,7,8,9-OCDD 64,090
2,3,7,8-TCDF <4.7
1,2,3,7,8-PeCDF 23.6
2,3,4,7,8-PeCDF 14.1
1,2,3,4,7,8-HxCDF 104
1,2,3,6,7,8-HxCDF 84.9
2,3,4,6,7,8-HxCDF 106
1,2,3,7,8,9-HxCDF <6.5
1,2,3,4,6,7,8-HpCDF 1,080
1,2,3,4,7,8,9-HpCDF 87.3
1,2,3,4,6,7,8,9-OCDF 1,780
032SB22 (12" TO 24")
SAMPLE ARCHIVED
2")
24")
032SB23 (0" TO 12")
SAMPLE ARCHIVED
032SB24 (12" TO 24")
SAMPLE ARCHIVED
SCALE
0



November 22, 1994

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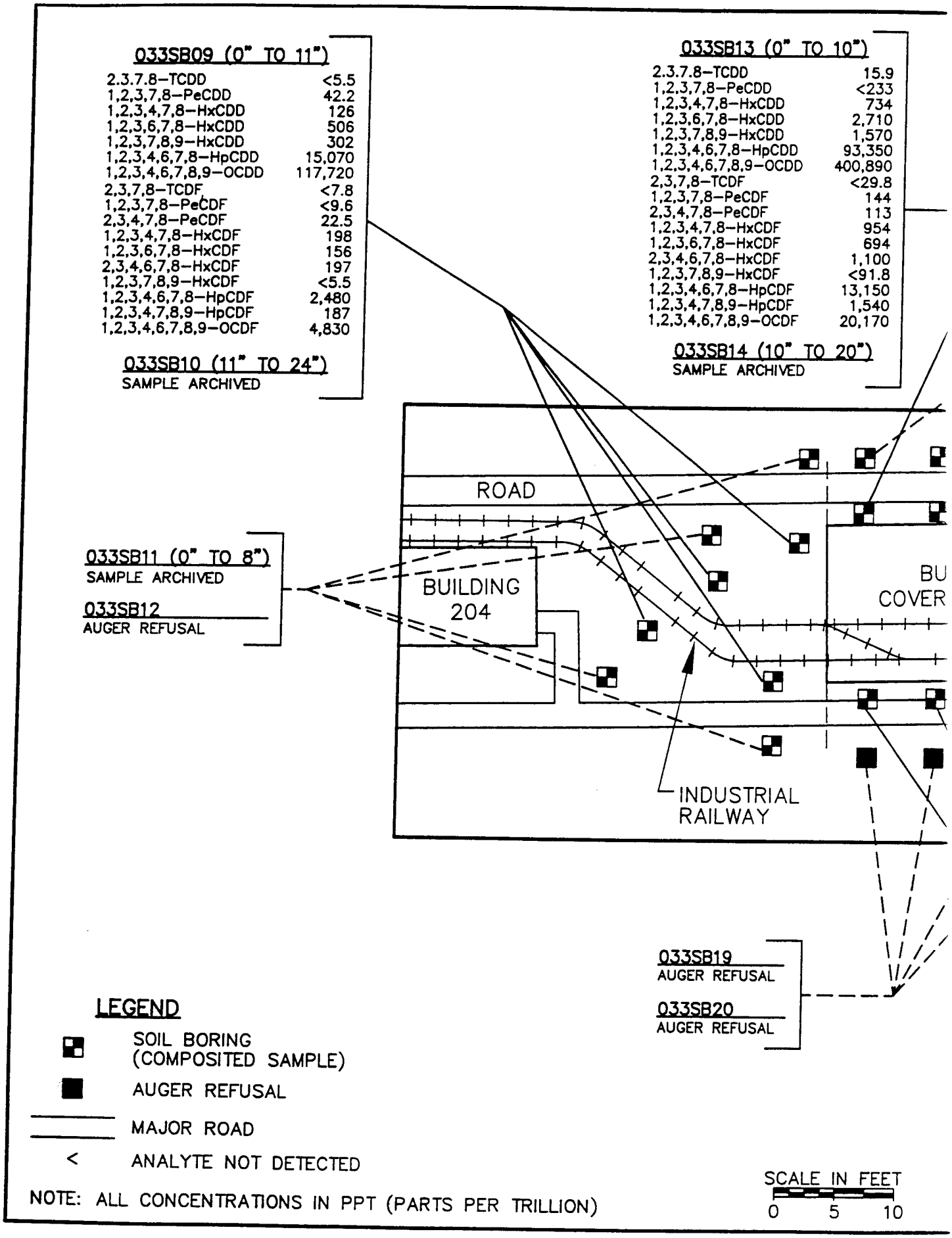
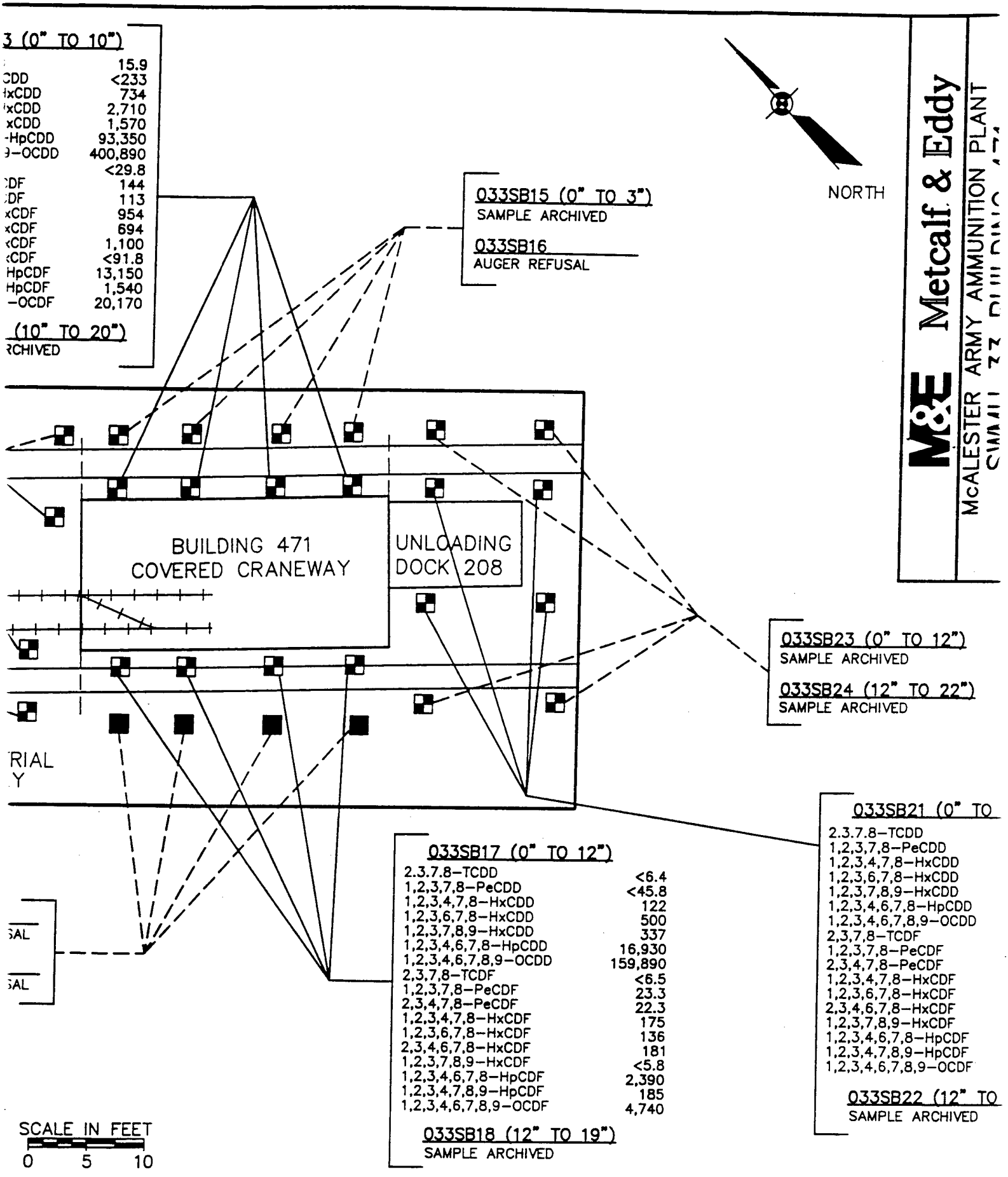
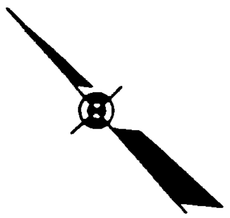

033SB09 (0" TO 11")
2,3,7,8-TCDD <5.5
1,2,3,7,8-PeCDD 42.2
1,2,3,4,7,8-HxCDD 126
1,2,3,6,7,8-HxCDD 506
1,2,3,7,8,9-HxCDD 302
1,2,3,4,6,7,8-HpCDD 15,070
1,2,3,4,6,7,8,9-OCDD 117,720
2,3,7,8-TCDF <7.8
1,2,3,7,8-PeCDF <9.6
2,3,4,7,8-PeCDF 22.5
1,2,3,4,7,8-HxCDF 198
1,2,3,6,7,8-HxCDF 156
2,3,4,6,7,8-HxCDF 197
1,2,3,7,8,9-HxCDF <5.5
1,2,3,4,6,7,8-HpCDF 2,480
1,2,3,4,7,8,9-HpCDF 187
1,2,3,4,6,7,8,9-OCDF 4,830
033SB10 (11" TO 24")
SAMPLE ARCHIVED
033SB13 (0" TO 10")
2,3,7,8-TCDD 15.9
1,2,3,7,8-PeCDD <233
1,2,3,4,7,8-HxCDD 734
1,2,3,6,7,8-HxCDD 2,710
1,2,3,7,8,9-HxCDD 1,570
1,2,3,4,6,7,8-HpCDD 93,350
1,2,3,4,6,7,8,9-OCDD 400,890
2,3,7,8-TCDF <29.8
1,2,3,7,8-PeCDF 144
2,3,4,7,8-PeCDF 113
1,2,3,4,7,8-HxCDF 954
1,2,3,6,7,8-HxCDF 694
2,3,4,6,7,8-HxCDF 1,100
1,2,3,7,8,9-HxCDF <91.8
1,2,3,4,6,7,8-HpCDF 13,150
1,2,3,4,7,8,9-HpCDF 1,540
1,2,3,4,6,7,8,9-OCDF 20,170
033SB14 (10" TO 20")
SAMPLE ARCHIVED
ROAD
033SB11 (0" TO 8")
SAMPLE ARCHIVED
033SB12
AUGER REFUSAL
BUILDING 204
BU
COVER
INDUSTRIAL RAILWAY
033SB19
AUGER REFUSAL
033SB20
AUGER REFUSAL
LEGEND
SOIL BORING (COMPOSITED SAMPLE)
AUGER REFUSAL
MAJOR ROAD
< ANALYTE NOT DETECTED
NOTE: ALL CONCENTRATIONS IN PPT (PARTS PER TRILLION)
SCALE IN FEET
0 5 10

(1)


3 (0" TO 10")
15.9
CDD <233
ixCDD 734
ixCDD 2,710
xCDD 1,570
-HpCDD 93,350
9-OCDD 400,890
<29.8
CDF 144
CDF 113
xCDF 954
xCDF 694
xCDF 1,100
CDF <91.8
HpCDF 13,150
HpCDF 1,540
-OCDF 20,170
(10" TO 20")
RCHIVED
033SB15 (0" TO 3")
SAMPLE ARCHIVED
033SB16
AUGER REFUSAL
NORTH
M&E Metcalf & Eddy
McALESTER ARMY AMMUNITION PLANT
BUILDING 471
COVERED CRANEWAY
UNLOADING
DOCK 208
033SB23 (0" TO 12")
SAMPLE ARCHIVED
033SB24 (12" TO 22")
SAMPLE ARCHIVED
RIAL
Y
033SB17 (0" TO 12")
2.3.7.8-TCDD <6.4
1,2,3,7,8-PeCDD <45.8
1,2,3,4,7,8-HxCDD 122
1,2,3,6,7,8-HxCDD 500
1,2,3,7,8,9-HxCDD 337
1,2,3,4,6,7,8-HpCDD 16,930
1,2,3,4,6,7,8,9-OCDD 159,890
2,3,7,8-TCDF <6.5
1,2,3,7,8-PeCDF 23.3
2,3,4,7,8-PeCDF 22.3
1,2,3,4,7,8-HxCDF 175
1,2,3,6,7,8-HxCDF 136
2,3,4,6,7,8-HxCDF 181
1,2,3,7,8,9-HxCDF <5.8
1,2,3,4,6,7,8-HpCDF 2,390
1,2,3,4,7,8,9-HpCDF 185
1,2,3,4,6,7,8,9-OCDF 4,740
033SB18 (12" TO 19")
SAMPLE ARCHIVED
033SB21 (0" TO
2.3.7.8-TCDD
1,2,3,7,8-PeCDD
1,2,3,4,7,8-HxCDD
1,2,3,6,7,8-HxCDD
1,2,3,7,8,9-HxCDD
1,2,3,4,6,7,8-HpCDD
1,2,3,4,6,7,8,9-OCDD
2,3,7,8-TCDF
1,2,3,7,8-PeCDF
2,3,4,7,8-PeCDF
1,2,3,4,7,8-HxCDF
1,2,3,6,7,8-HxCDF
2,3,4,6,7,8-HxCDF
1,2,3,7,8,9-HxCDF
1,2,3,4,6,7,8-HpCDF
1,2,3,4,7,8,9-HpCDF
1,2,3,4,6,7,8,9-OCDF
033SB22 (12" TO
SAMPLE ARCHIVED
SAL
SAL
SCALE IN FEET
0 5 10

(2)



M&E Metcalf & Eddy

McALESTER ARMY AMMUNITION PLANT
SWMU 33 BUILDING 471
ORGANIC CONCENTRATIONS
SOIL BORING SAMPLES

FILE NAME	DATE	DRAWN	SCALE	PROJECT NO.	FIGURE
AN33-3	11/9/94	CAP	1"=10'	010933-6	2

033SB23 (0" TO 12")
SAMPLE ARCHIVED

033SB24 (12" TO 22")
SAMPLE ARCHIVED

033SB21 (0" TO 12")

2,3,7,8-TCDD	7.7
1,2,3,7,8-PeCDD	282
1,2,3,4,7,8-HxCDD	703
1,2,3,6,7,8-HxCDD	2,120
1,2,3,7,8,9-HxCDD	1,650
1,2,3,4,6,7,8-HpCDD	58,370
1,2,3,4,6,7,8,9-OCDD	188,620
2,3,7,8-TCDF	97.9
1,2,3,7,8-PeCDF	214
2,3,4,7,8-PeCDF	163
1,2,3,4,7,8-HxCDF	936
1,2,3,6,7,8-HxCDF	775
2,3,4,6,7,8-HxCDF	1,060
1,2,3,7,8,9-HxCDF	<18.1
1,2,3,4,6,7,8-HpCDF	9,090
1,2,3,4,7,8,9-HpCDF	801
1,2,3,4,6,7,8,9-OCDF	8,030

033SB22 (12" TO 24")
SAMPLE ARCHIVED

(3)

8.0 REFERENCES

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Washington, DC, OSWER Directive 9355.0-30, April 22, 1991.

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SWMU #32- Table 1

Section A Sample Location	Distance From Building (Inches)	Depth of Sample (inches)	Date Sampled	Sample Analyzed or Archived
032SB09-1	19	0 To 12	August 18, 1994	Analyzed
032SB09-2	6	0 To 12	August 18, 1994	Analyzed
032SB09-3	6	0 To 12	August 18, 1994	Analyzed
032SB09-4	12	0 To 12	August 18, 1994	Analyzed
032SB10-1	19	12 To 24	August 18, 1994	Archived
032SB10-2	6	12 To 24	August 18, 1994	Archived
032SB10-3	6	12 To 24	August 18, 1994	Archived
032SB10-4	12	12 To 13 Auger Refusal	August 18, 1994	Archived
032SB11-1	68	0 To 12	August 18, 1994	Archived
032SB11-2	89	0 To 12	August 18, 1994	Archived
032SB11-3	204	0 To 12	August 18, 1994	Archived
032SB11-4	206	0 To 12	August 18, 1994	Archived
032SB12-1	68	12 To 24	August 18, 1994	Archived
032SB12-2	89	12 To 24	August 18, 1994	Archived
032SB12-3	204	12 To 24	August 18, 1994	Archived
032SB12-4	206	12 To 24	August 18, 1994	Archived

Section A is the Northwest Quadrant

SWMU #32- Table 1 (Continued)

Section B Sample Location	Distance From Building (Inches)	Depth of Sample (inches)	Date Sampled	Sample Analyzed or Archived
032SB13-1	16	0 To 12	August 18, 1994	Analyzed
032SB13-2	8	0 To 12	August 18, 1994	Analyzed
032SB13-3	8	0 To 2 Auger Refusal	August 18, 1994	Analyzed
032SB13-4	12	0 To 3 Auger Refusal	August 18, 1994	Analyzed
032SB14-1	16	12 To 24	August 18, 1994	Archived
032SB14-2	8	12 To 24	August 18, 1994	Archived
032SB14-3	8	Auger Refusal	August 18, 1994	Archived
032SB14-4	12	Auger Refusal	August 18, 1994	Archived
032SB15-1	56	0 To 12	August 18, 1994	Archived
032SB15-2	183	0 To 12	August 18, 1994	Archived
032SB15-3	187	0 To 12	August 18, 1994	Archived
032SB15-4	186	0 To 12	August 18, 1994	Archived
032SB16-1	56	12 To 24	August 18, 1994	Archived
032SB16-2	183	12 To 24	August 18, 1994	Archived
032SB16-3	187	12 To 24	August 18, 1994	Archived
032SB16-4	186	12 To 24	August 18, 1994	Archived

Section B is the Northeast Quadrant

SWMU #32- Table 1 (Continued)

Section C Sample Location	Distance From Building (Inches)	Depth of Sample (inches)	Date Sampled	Sample Analyzed or Archived
032SB17-1	9	0 To 7 Auger Refusal	August 19, 1994	Analyzed
032SB17-2	24	0 To 9	August 19, 1994	Analyzed
032SB17-3	22	0 To 10 Auger Refusal	August 19, 1994	Analyzed
032SB17-4	19	0 To 11	August 19, 1994	Analyzed
032SB18-1	9	Auger Refusal	August 19, 1994	Archived
032SB18-2	24	9 To 24	August 19, 1994	Archived
032SB18-3	22	10 To 18 Auger Refusal	August 19, 1994	Archived
032SB18-4	19	11 To 18 Auger Refusal	August 19, 1994	Archived
032SB19-1	48	0 To 4 Auger Refusal	August 18, 1994	Archived
032SB19-2	84	Auger Refusal	August 18, 1994	Archived
032SB19-3	58	0 To 8 Auger Refusal	August 18, 1994	Archived
032SB19-4	55	0 To 12	August 18, 1994	Archived
032SB20-1	48	Auger Refusal	August 18, 1994	Archived
032SB20-2	84	Auger Refusal	August 18, 1994	Archived
032SB20-3	58	Auger Refusal	August 18, 1994	Archived
032SB20-4	55	12 To 24	August 18, 1994	Archived

Section C is the Southwest Quadrant

SWMU #32- Table 1 (Continued)

Section D Sample Location	Distance From Building (Inches)	Depth of Sample (inches)	Date Sampled	Sample Analyzed or Archived
032SB21-1	3	0 To 10	August 18, 1994	Analyzed
032SB21-2	20	0 To 11	August 18, 1994	Analyzed
032SB21-3	23	0 To 11	August 18, 1994	Analyzed
032SB21-4	15	0 To 12	August 18, 1994	Analyzed
032SB22-1	3	10 To 22 Auger Refusal	August 18, 1994	Archived
032SB22-2	20	11 To 24	August 18, 1994	Archived
032SB22-3	23	11 To 24	August 18, 1994	Archived
032SB22-4	15	12 To 24	August 18, 1994	Archived
032SB23-1	39	0 To 8 Auger Refusal	August 18, 1994	Archived
032SB23-2	56	0 To 12	August 18, 1994	Archived
032SB23-3	59	0 To 8 Auger Refusal	August 18, 1994	Archived
032SB23-4	41	0 To 12	August 18, 1994	Archived
032SB24-1	39	Auger Refusal	August 18, 1994	Archived
032SB24-2	56	Auger Refusal	August 18, 1994	Archived
032SB24-3	59	Auger Refusal	August 18, 1994	Archived
032SB24-4	41	12 To 24	August 18, 1994	Archived

Section D is the Southeast Quadrant

SWMU #32- Table 1 (Continued)

Section D Sample Location	Distance From Building (Inches)	Depth of Sample (inches)	Date Sampled	Sample Analyzed or Archived
032SB21-1	3	0 To 10	August 18, 1994	Analyzed
032SB21-2	20	0 To 11	August 18, 1994	Analyzed
032SB21-3	23	0 To 11	August 18, 1994	Analyzed
032SB21-4	15	0 To 12	August 18, 1994	Analyzed
032SB22-1	3	10 To 22 Auger Refusal	August 18, 1994	Archived
032SB22-2	20	11 To 24	August 18, 1994	Archived
032SB22-3	23	11 To 24	August 18, 1994	Archived
032SB22-4	15	12 To 24	August 18, 1994	Archived
032SB23-1	39	0 To 8 Auger Refusal	August 18, 1994	Archived
032SB23-2	56	0 To 12	August 18, 1994	Archived
032SB23-3	59	0 To 8 Auger Refusal	August 18, 1994	Archived
032SB23-4	41	0 To 12	August 18, 1994	Archived
032SB24-1	39	Auger Refusal	August 18, 1994	Archived
032SB24-2	56	Auger Refusal	August 18, 1994	Archived
032SB24-3	59	Auger Refusal	August 18, 1994	Archived
032SB24-4	41	12 To 24	August 18, 1994	Archived

Section D is the Southeast Quadrant

SWMU #33 Table 2

Section A Sample Location	Distance From Building (Inches)	Depth of Sample (inches)	Date Sampled	Sample Analyzed or Archived
033SB09-1	12	0 To 11	August 18, 1994	Analyzed
033SB09-2	12	0 To 11	August 18, 1994	Analyzed
033SB09-3	12	0 To 4 Auger Refusal	August 18, 1994	Analyzed
033SB09-4	34	0 To 9	August 18, 1994	Analyzed
033SB10-1	12	12 To 24	August 18, 1994	Archived
033SB10-2	12	12 To 24	August 18, 1994	Archived
033SB10-3	12	Auger Refusal	August 18, 1994	Archived
033SB10-4	34	Auger Refusal	August 18, 1994	Archived
033SB11-1	72	0 To 2 Auger Refusal	August 18, 1994	Archived
033SB11-2	48	0 To 8 Auger Refusal	August 18, 1994	Archived
033SB11-3	48	0 To 2 Auger Refusal	August 18, 1994	Archived
033SB11-4	70	0 To 2 Auger Refusal	August 18, 1994	Archived
033SB12-1	72	Auger Refusal	August 18, 1994	Archived
033SB12-2	48	Auger Refusal	August 18, 1994	Archived
033SB12-3	48	Auger Refusal	August 18, 1994	Archived
033SB12-4	70	Auger Refusal	August 18, 1994	Archived

Section A is the North Quadrant

SWMU #33 Table 2 (Continued)

Section B Sample Location	Distance From Building (Inches)	Depth of Sample (inches)	Date Sampled	Sample Analyzed or Archived
033SB13-1	12	0 To 6	August 19, 1994	Analyzed
033SB13-2	35	0 To 10	August 19, 1994	Analyzed
033SB13-3	29	0 To 10 Auger Refusal	August 19, 1994	Analyzed
033SB13-4	19	0 To 3 Auger Refusal	August 19, 1994	Analyzed
033SB14-1	12	Auger Refusal	August 19, 1994	Archived
033SB14-2	35	Auger Refusal	August 19, 1994	Archived
033SB14-3	29	10 To 20 Auger Refusal	August 19, 1994	Archived
033SB14-4	19	Auger Refusal	August 19, 1994	Archived
033SB15-1	48	Auger Refusal	August 19, 1994	Archived
033SB15-2	71	Auger Refusal	August 19, 1994	Archived
033SB15-3	65	0 To 2 Auger Refusal	August 19, 1994	Archived
033SB15-4	55	0 To 3 Auger Refusal	August 19, 1994	Archived
033SB16-1	56	12 To 24	August 19, 1994	Archived
033SB16-2	183	12 To 24	August 19, 1994	Archived
033SB16-3	187	12 To 24	August 19, 1994	Archived
033SB16-4	186	12 To 24	August 19, 1994	Archived

Section B is the East Quadrant

SWMU #33 Table 2 (Continued)

Section C Sample Location	Distance From Building (Inches)	Depth of Sample (inches)	Date Sampled	Sample Analyzed or Archived
033SB17-1	24	0 To 7 Auger Refusal	August 19, 1994	Analyzed
033SB17-2	19	0 To 12	August 19, 1994	Analyzed
033SB17-3	20	0 To 5 Auger Refusal	August 19, 1994	Analyzed
033SB17-4	19	0 To 3 Auger Refusal	August 19, 1994	Analyzed
033SB18-1	24	12 To 15	August 19, 1994	Archived
033SB18-2	19	12 To 19 Auger Refusal	August 19, 1994	Archived
033SB18-3	20	Auger Refusal	August 19, 1994	Archived
033SB18-4	19	Auger Refusal	August 19, 1994	Archived
033SB19-1	24	Auger Refusal	August 19, 1994	Archived
033SB19-2	19	Auger Refusal	August 19, 1994	Archived
033SB19-3	20	Auger Refusal	August 19, 1994	Archived
033SB19-4	19	Auger Refusal	August 19, 1994	Archived
033SB20-1	48	Auger Refusal	August 19, 1994	Archived
033SB20-2	84	Auger Refusal	August 19, 1994	Archived
033SB20-3	58	Auger Refusal	August 19, 1994	Archived
033SB20-4	55	12 To 24	August 19, 1994	Archived

Section C is the West Quadrant

SWMU #33 Table 2 (Continued)

Section D Sample Location	Distance From Building (Inches)	Depth of Sample (inches)	Date Sampled	Sample Analyzed or Archived
033SB21-1	22	0 To 12	August 19, 1994	Analyzed
033SB21-2	16	0 To 6 Auger Refusal	August 19, 1994	Analyzed
033SB21-3	27	0 To 4 Auger Refusal	August 19, 1994	Analyzed
033SB21-4	30	0 To 12	August 19, 1994	Analyzed
033SB22-1	22	12 To 24	August 19, 1994	Archived
033SB22-2	16	Auger Refusal	August 19, 1994	Archived
033SB22-3	27	Auger Refusal	August 19, 1994	Archived
033SB22-4	30	12 To 15 Auger Refusal	August 19, 1994	Archived
033SB23-1	58	0 To 12	August 19, 1994	Archived
033SB23-2	52	0 To 6 Auger Refusal	August 19, 1994	Archived
033SB23-3	63	0 To 4.5 Auger Refusal	August 19, 1994	Archived
033SB23-4	66	0 To 6.5 Auger Refusal	August 19, 1994	Archived
033SB24-1	58	12 To 22	August 19, 1994	Archived
033SB24-2	52	Auger Refusal	August 19, 1994	Archived
033SB24-3	63	Auger Refusal	August 19, 1994	Archived
033SB24-4	66	Auger Refusal	August 19, 1994	Archived

Section D is the South Quadrant

APPENDIX A

SAMPLE SUMMARY TABLES